



Session 6

Dynamic Modeling and Systems Analysis

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| 1:00 – 1:05p | Overview – Jeffrey Csank |
| 1:05 – 1:30p | Dynamic Systems Analysis – Jeffrey Csank |
| 1:30 – 1:55p | T-MATS (Toolbox for the Modeling and Analysis of Thermodynamic Systems) – Jeffryes Chapman |
| 1:55 – 2:20p | Reducing Conservatism in Aircraft Engine Response Using Conditionally Active Min-Max Regulators – Ryan May |

4th Propulsion Control and Diagnostics Workshop
Ohio Aerospace Institute (OAI)
Cleveland, OH
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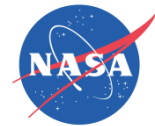
Dynamic Systems Analysis

- Preliminary Engine Design
 - Systems Analysis (Steady state)
 - Lack of dynamic performance information
 - Historical data (past experiences)
 - Additional conservatism in the design
- Dynamic Systems Analysis
 - Better predict/account for dynamic operation in PED
 - Allow for trade-offs between performance and operability margins to meet future engine performance requirements
 - Enabled through the Tool for Turbine Engine Closed-loop Transient Analysis (TTECTrA)



T-MATS (Toolbox for the Modeling and Analysis of Thermodynamic Systems)

- Simulation System designed to give a user a library containing building blocks that may be used to create dynamic Thermodynamic systems. Includes:
 - Iterative Solving capability
 - Generic Thermodynamic Component models
 - Turbomachinery components (compressor, turbine, burner, nozzle, etc.)
 - Control system modeling (controller, actuator, sensor, etc.)
- MATLAB/Simulink Based
- Open Source (free of proprietary and export restrictions)
- Development of T-MATS is being led by NASA Glenn Research Center
 - NASA's focus for this project is on the modeling of aerospace applications, however the T-MATS framework is extremely general and can be applied to any thermodynamic model.



Reducing Conservatism in Aircraft Engine Response Using Conditionally Active Min-Max Limit Regulators

- Typical aircraft engine control is based on a Min-Max scheme
- Designed to keep the engine operating within prescribed mechanical and operational safety limits
 - Compares fuel flow to determine the limit that is closest to being violated
 - Conservative
- Improve engine performance by allowing the limit regulators to only be active when a limit is in danger of being violated.